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THREE NEW MITES OF THE SUBFAMILY RHIZOGLYPHINAE*

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The subfamily Rhizoglyphinae is a group which was reclassified by the Russian Zoologist, A. A. Zakhvatkine,† in 1937. As a result of his studies he became convinced that Oudemans' 1923-1932 classification of the Diacotricha was unstable and very artificial. Accordingly, he proposed that the family Tyroglyphidae Don. 1876 be divided into two subfamilies, the Rhizoglyphinae (Oud.) A.Z., and the Tyroglyphinae (Oud.) A. Z. As the latter of these is based on Linnaeus' genus *Acarus*, Ewing and Nesbitt, 1942‡, pointed out that the correct name for the family is Acaridae instead of Tyroglyphidae which should fall into synonymy.

Caloglyphus anomalus n. sp.

In examining some partially destroyed lily bulbs from Ottawa, Canada, several caloglyphid mites were found in different stages of development, which were particularly interesting in that the males showed no evidence of anal copulatory suckers. This is a rather unusual feature because these structures are characteristic of the family Acaridae (Tyroglyphidae).

Description: The propodosoma bears a pair of rostral setae extending beyond the tips of the chelicerae; a pair of minute vertical bristles at the middle of the lateral sides of the heavy propodosomal escutcheon; two pairs of propodosomal setae placed in a transverse row in the hind part of the propodosoma, the inner pair of which are about one-quarter as long as the outer; and laterally a pair of nuchal hairs which are so closely pressed against the sides of the propodosoma that they are seen with difficulty in dorsal or ventral views. The pseudostigmatic organs are smooth and minute. The opisthosoma has eight pairs of setae on the dorsal side, viz., three pairs of setae in a transverse row just posterior to the dorsal sulcus, the two inner pairs of these being short, the outer or humeral longer than one-half the width of the body; two pairs of setae located one behind the other in the centre of the hysterosoma; one pair placed laterally just anterior to the excretory pore; and two pairs of setae located, the one at the posterolateral corner of the opisthosoma, the other pair at the extreme posterior end. Ventrally, there are several pairs of setae: one pair of anterior epimeral bristles (between epimera I and II); one pair of minute humeral bristles; one pair of posterior epimeral bristles (between epimera III and IV); three pairs of paragenital bristles; several pairs of anal bristles; and three pairs of posterior opisthosomatic setae, the most anterior pair of which are short and marginal, the posterior pairs are quite large and placed one close to the median line and the other more laterally and on the posterior margin of the body.

The legs are long and bear the typical spines of caloglyphid mites. The tarsi in all three forms (with the exception of tarsus III of the heteromorphic males) have parallel sides and are slightly longer than the combined length of the two preceding segments. Their terminal setae are distally modified as falcate paddles. Tarsi I, II and III each bear two such structures and a third seta which

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†A. A. Zakhvatkine, 1937, Wiss. Ber. Moskau St. Univ. 3:169-202, 4 pls.

‡Ewing, H. E. and Nesbitt, H. H. J., 1942, Proc. Biol. Soc. Wash. 55:121-124.

usually carries a narrow paddle but which may remain as a simple hair. Tarsus IV has two narrow paddles in the female, and one in each of the males. The anus in all three forms is removed from the posterior end of the opisthosoma by a distance greater than its own length.

Females: (Not figured—Chaetotaxy similar to that of normal male, *vide* fig. 1). The mature females are .84 to .98 mm. long and .48 to .53 mm. wide; shiny greyish-white in colour although the gut contents may make the animal appear brownish. The legs and other heavily chitinized parts, such as the propodosomal escutcheon, are light brown. The opisthosomatic setae of the female, with the exception of the humeral bristles, are quite short in comparison with those of the heteromorphic male or those of the female of *Caloglyphus berlesei* (Mich.). The anus is flanked by six pairs of bristles arranged in two rows on each side of it; those of the outer row are almost twice as long as those of the inner. The legs are about three-fifths as long as the greatest width of the opisthosoma, i. e., equal in length to those of the normal male but slightly shorter than those of the heteromorphic male. The tarsi are similar in all three types with the differences noted above (two falcate hairs on tarsus IV of the female).

Mature females may contain up to eighteen or twenty thick-shelled, brownish eggs. The bursa copulatrix is a minute pore at the extreme posterior end of the opisthosoma.

Normal Males: (fig. 1). The mature males are .84 to .94 mm. long and .44 to .45 mm. wide. The dorsal chaetotaxy is similar to that of the female (as may be seen from the figures, the setae are about one-half the length of those in the heteromorphic male); the shape of the body, however, is not as globose posteriorly. The epimera (*vide* fig. 1) are covered by chitinized areas of the integument which are light brown in life and are represented by stippling in the drawing. The anus is flanked by three pairs of bristles, the hindmost pair of which is placed well behind it. There is no suggestion of anal copulatory suckers. Tarsus IV of the male bears two suckers distally.

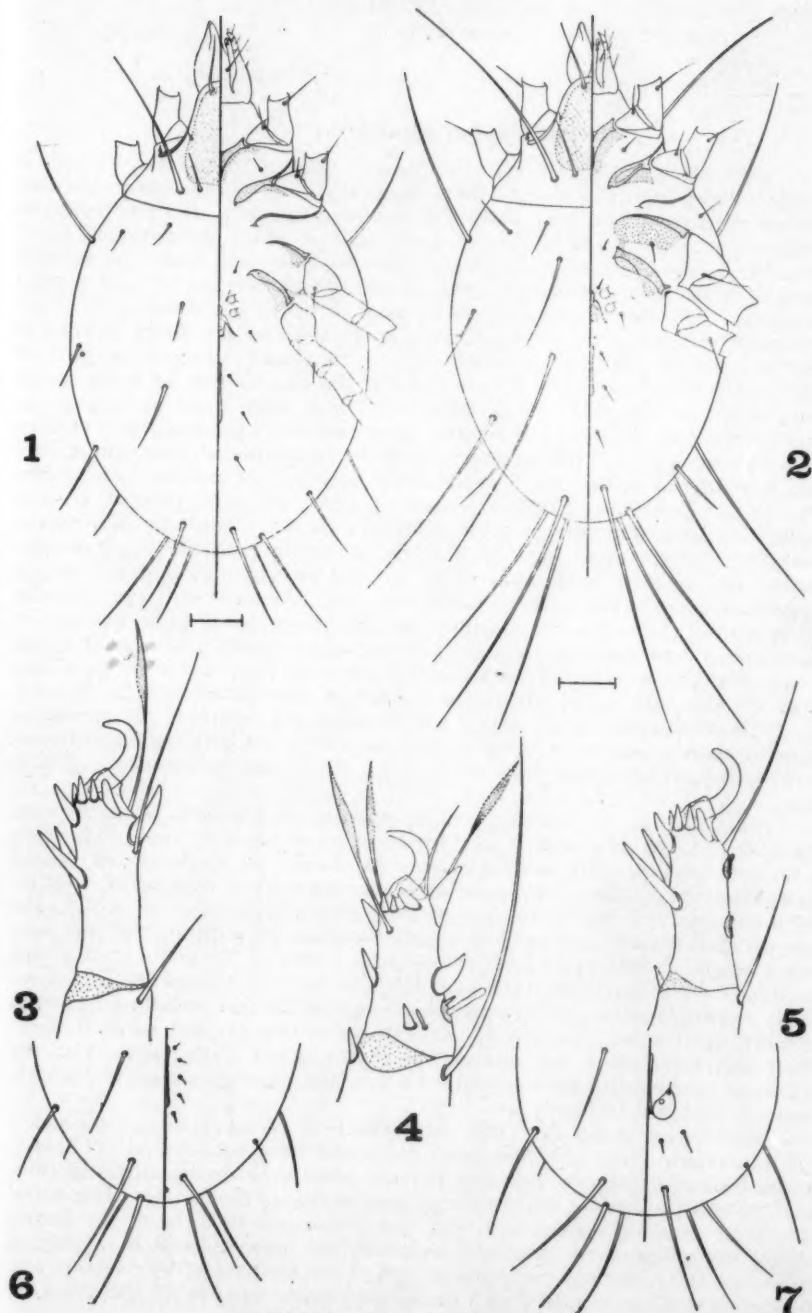
Heteromorphic Males: (fig. 2). While the heteromorphic males are slightly smaller than the females, being .88 to .95 mm. long and .45 to .53 mm. wide at the humeral setae, they appear much larger because of the longer body hairs and slightly longer legs. They differ from the male and the female in two major respects, viz., in the length of the principal body hairs which are about as long as the body is wide; and in the possession of a claw-like third tarsus. Generally speaking, the heteromorphic male is more sturdily built than the normal male, in that the chitinized areas over the epimera are much larger in extent, and in that it possesses larger third and fourth coxae. Here again the anus is flanked by three pairs of bristles the hindmost pair of which is placed well behind it. There is no suggestion of anal copulatory suckers. The penis in both males is heavily built and rounded at the tip.

In view of the fact that the mite described above differs from all other members of the family Acaridae in its lack of anal copulatory suckers, one would be tempted to create a new group for it. I think, however, that this would be a mistake because in all other respects it is a respectable member of the genus *Caloglyphus* and occupies a position close to *Caloglyphus berlesei* (Mich.) and *Caloglyphus armipes* (Banks). Had the condition been found in but one or two individuals we could attribute it to abnormal development, but in so far as it was found in a fairly large population in 1940, which was maintained for about a year, I consider it a good species and have given it the specific name "*anomalus*".

This species may be distinguished readily from the other members of the genus by the absence of copulatory suckers in the male, and by the relatively short hairs and the number of falcate terminal tarsal setae in the female.

Type habitat: Decaying lily bulbs, Ottawa, Canada.

PLATE II



NEW RHIZOGLYPHINE MITES

Type: Heteromorphic male, Ottawa, July 3, 1940 (H. H. J. Nesbitt); No. 5478 in the Canadian National Collection, Ottawa.

Morphotype: normal ♂, same data.

Allotype: ♀, same data.

Paratypes: 11 heteromorphic ♂♂, 8 ♂♂, 17 ♀♀, same data.

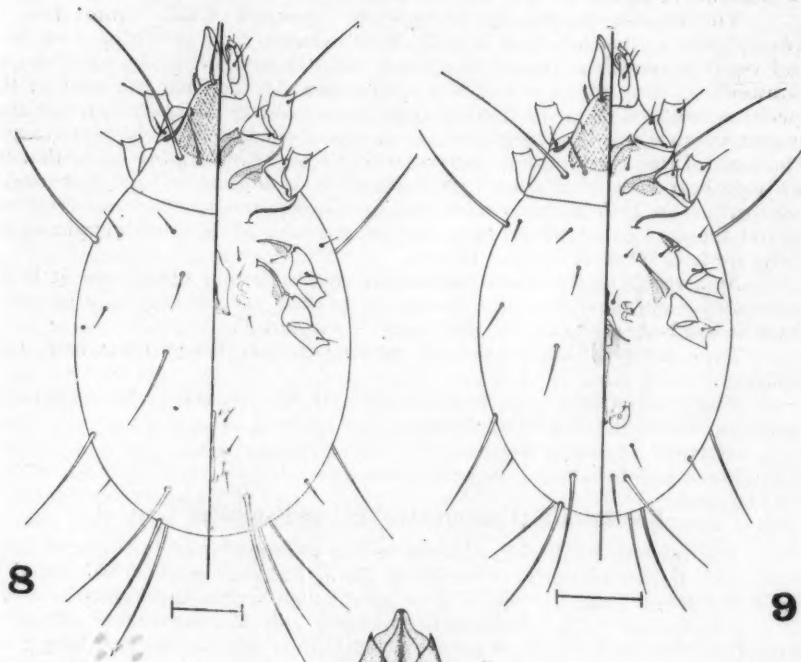
***Rhizoglyphus rotundatus* n. sp.**

Description: The propodosoma bears a pair of rostral setae; a pair of minute vertical bristles at the middle of the lateral sides of the lightly chitinized prododosomal escutcheon; two pairs of propodosomal setae placed in a transverse row anterior to the dorsal sulcus, the inner pair of which are extremely small, the outer are about two-thirds as long as the propodosoma is wide; and laterally a pair of spine-like nuchal setae. The pseudostigmatic organs are tiny peg-like structures. The hysterosoma bears nine pairs of setae on the dorsal face, viz., three pairs of setae in a transverse row just posterior to the dorsal sulcus, the inner of which are short, the outer or humeral are almost as long as one-half the width of the body; two pairs of setae located the one behind the other in the centre of the hysterosoma, the posterior are about three times as long as the anterior; one pair of setae anterior to the excretory pore; one pair of fairly stout setae at the posterolateral corners of the opisthosoma; one pair of long setae just anterior to the hind margin of the opisthosoma and one pair of long setae on the posterior margin. Ventrally, there are: one pair of anterior epimeral bristles; one pair of minute humeral bristles; one pair of posterior epimeral bristles; three pairs of paragenital bristles; several pairs of anal bristles; one pair of small setae close the the margin and posterior to the posterolateral corners of the opisthosoma; and one pair of large setae removed a short distance from the hind margin of the body. The legs are relatively short and bear the typical spines of rhizoglyphid mites; tarsi I and II bear distally three small falcate hairs, tarsus III has two such hairs and tarsus IV only one. The distinctive feature of this species is that tarsus I, (fig. 4) bears a large conical-shaped parasubbasal seta, which is not present in any other known member of the genus *Rhizoglyphus*. In both male and female the hysterosoma, being relatively short and wide, assumes a rotund or globose form.

Female: (figs. 3, 4, and 6). When mature, the female is .68 to .79 mm. long and .42 to .45 mm. wide; shiny greyish-white to fawn in colour depending on the type and quantity of food eaten. As there is no evidence of sexual dimorphism, the opisthosomatic setae in the two sexes are of approximately equal length and relatively similar to those of *Rhizoglyphus echinopus* (F. & R.). The anus, which is distant from the hind end of the body by a distance greater than its own length, is flanked by five pairs of little bristles. Normally a sixth pair should have been found but as yet it has not been seen. Although the first tarsus (fig. 4) is scarcely as long as the combined length of the two preceding segments, and although it bears the typically heavy spines of rhizoglyphid mites, it shows certain characters which are reminiscent of the genus *Caloglyphus*, viz., the presence of the conical-shaped parasubbasal seta, and its general shape and length. Tarsus IV is shown in figure 3.

Male: (figs. 5 and 7). The normal male is .65 to .68 mm. long and .3 to .4 mm. wide. As yet no heteromorphic males have been found. There is likewise little evidence of sexual dimorphism, other than the usual observations that the male opisthosoma is not quite as large as that of the female. The dorsal and ventral setae are similar in length and disposition to those of the female with the exception of the anal bristles which are here replaced by a pair of bristles located on the extreme anterior end of the anal copulatory suckers and two pairs of small setae placed in a transverse convex row behind these suckers.

PLATE III



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NEW RHIZOGLYPHINE MITES

Tarsus I of the male is similar, if not identical, to that of the female. Tarsus IV is shown in figure 5. The penis is pointed.

The females of this species may be separated readily from those of *Rhizoglyphus echinopus* (F. & R.), the most common mite of rotting mushroom and vegetable material, by two characters, viz., the presence of a conical-shaped parasubbasal seta on tarsus I of this species and the fact that the anus of this species is removed from the hind margin of the body by a distance greater than its own length whilst in *Rhizoglyphus echinopus* it is adjacent to the hind margin. The male of this species differs from that of *Rhizoglyphus echinopus* in that the first tarsi bear the conical-shaped parasubbasal setae, and in that the four longish hairs, which in *Rhizoglyphus echinopus* are placed in a convex, transverse row behind the anal copulatory suckers and extend beyond the hind margin of the body, are here reduced to short bristles.

As a result of the above mentioned characters and differences, it is the writer's opinion that this mite constitutes a good species and because of its shape it has been given the specific name "*rotundatus*".

Type habitat: On mushroom growing in Mer Bleue (peat bog) near Ottawa.

Type: ♀, Ottawa, Ont., Sept. 16, 1941 (H. H. J. Nesbitt); No. 5479 in the Canadian National Collection, Ottawa.

Allotype: ♂, same data.

Paratypes: 1 ♀ and 1 ♂, same data.

***Eberhardia* (*Cosomoglyphus*) *pedispinifer* n. sp.**

The mite to be described below is one of a group of caloglyphid mites which were found inhabiting a sample of damp and rotting wheat submitted by Mr. P. C. Brown from the basement of an elevator in Estevan, Saskatchewan.

Description: The propodosoma bears a pair of rostral setae extending beyond the tips of the chelicerae; a pair of minute vertical bristles, beside the propodosomal escutcheon; two pairs of propodosomal setae placed in a transverse row in the hind part of the propodosoma, the inner pair of which are about one-third as long as the outer which are as long as the propodosoma is wide; and laterally a pair of horn-like nuchal setae. The pseudostigmal organs are moderately long and slightly pectinated. The opisthosoma has nine pairs of setae on the dorsal side, viz., three pairs of setae in a transverse row just posterior to the dorsal sulcus, the two inner pairs of which are short, the outer or humeral are as long as one-half of the width of the body at its widest part; two pairs of setae located one behind the other in the centre of the hysterosoma, the anterior pair are short, the posterior pair are two-thirds of the length of the humeral setae; one pair of short setae placed laterally just anterior to the excretory pore; one pair of setae almost as long as the humerals located at the posterolateral corner of the opisthosoma; and two pairs of setae, both slightly longer than the humerals, placed the one just anterior to the hind margin of the body and the other at the extreme posterior end of the body. Ventrally, there are several pairs of bristles and setae: a pair each of anterior epimeral, posterior epimeral and humeral bristles; three pairs of paragenital bristles, six pairs of anal bristles in the female; and two pairs of posterior opisthosomatic bristles, the one longer than the humerals and located just posterior and laterad of the anus, the other very short and placed close to the lateral margins near the posterolateral corners.

The legs are of medium length and bear the typical spines of acarid mites. Tarsus I, equal in length to the two preceding segments, is shown in figure 11. It differs from any of the members of the genus *Caloglyphus* (the most closely allied genus) in two major respects, viz., the lateral and mesial median setae, which bear falcate paddle-like dilatations in the genus *Caloglyphus*, are unmodified and retain their primitive position (i. e., are simple seta in the middle reaches of the tarsus); and the second dorsal terminal seta is represented by a

small peg-like spine whilst in the genus *Caloglyphus* it is a large thorn-like process of the dorsal distal corner of the tarsus.

Female: (fig. 8, 11, 13). The mature females are .68 to .75 mm. long and .35 to .44 mm. wide, shiny greyish-white in colour, with fawn to brownish coloured legs, chelicerae, and other such heavily chitinated parts. The dorsal and ventral chaetotaxy is shown in figure 8. The anus, removed from the hind margin of the body by a distance equal to one-half of its own length, is flanked by six pairs of bristles arranged in two more or less distinct rows on each side. The outer row is composed of three fairly large bristles and the inner row of three much smaller ones. The opening to the bursa copulatrix is a minute pore at the extreme posterior end. The fourth tarsus is shown in figure 13. It is greater in length than the combined length of the two preceding segments. Distally it bears two simple setae.

Males (fig. 9, 10, 12). The mature males are .55 to .56 mm. long and .29 to .32 mm. wide, pearly greyish-white in colour with brownish coloured legs, chelicerae and propodosomal escutcheon. The dorsal and ventral chaetotaxy is shown in figure 9. In place of the female anal setae, the male has three extra pairs of setae. These are: one pair of little bristles with conspicuous basal sockets just anterior to the anal copulatory suckers; a pair of short setae halfway between the anal copulatory suckers and the largest posterior opisthosomatic setae; and a pair of short setae which extend beyond the posterior margin of the opisthosoma and which arise mesiad to the largest ventral opisthosomatic setae forming with them a transverse row of four setae. The penis (figure 10) is blunt and supported by heavily chitinated rami. Just posterior to it lies the anus which is removed from the posterior end of the body by a distance greater than its own length. The suckers on tarsus IV are so placed that the segment is divided into three approximately equal parts. Distally the tarsi bear a single unmodified seta. No heteromorphic males have been found.

In view of the fact that there appears to be little evidence of sexual dimorphism, and no heteromorphic males, this species should be placed in the subgenus *Cosmoglyphus* Oudemans, 1923. As far as the exact position in this genus is concerned, the mite described above stands close to *Eberhardia* (*Cosmoglyphus*) *agilis* Can. 1881, from which it differs in a few minor details. It is likewise very similar to a species of the genus *Eberhardia* described, but not named by Jary, in the Journal of South Eastern Agricultural College, Wye, Kent, 1938, No. 42:72-73.

Type habitat: Rotting wheat, Estevan, Sask., January, 1941.

Type: ♀, Estevan, Sask., Jan. 17, 1941 (P. C. Brown); No. 5480 in the Canadian National Collection, Ottawa.

Allotype: same data.

Paratypes: 5 ♂♂, 21 ♀♀, same data.

EXPLANATION OF PLATES II AND III

The heavy black line below figures 1, 2, 8, and 9, represents 0.1 mm.

1. Dorsal and ventral view of *Caloglyphus anomalus* n. sp., normal ♂.
2. Dorsal and ventral view of *Caloglyphus anomalus* n. sp., heteromorphic ♂.
3. Tarsus IV of ♀ of *Rhizoglyphus rotundatus* n. sp.
4. Tarsus I of *Rhizoglyphus rotundatus* n. sp.
5. Tarsus IV of ♂ of *Rhizoglyphus rotundatus* n. sp.
6. Dorsal and ventral view of end of opisthosoma of ♀ of *Rhizoglyphus rotundatus* n. sp.
7. Dorsal and ventral view of end of opisthosoma of ♂ of *Rhizoglyphus rotundatus* n. sp.
8. Dorsal and ventral view of ♀ of *Eberhardia pedispinifer* n. sp.
9. Dorsal and ventral view of ♂ of *Eberhardia pedispinifer* n. sp.
10. Penis of *Eberhardia pedispinifer* n. sp.
11. Tarsus I of ♀ of *Eberhardia pedispinifer* n. sp.
12. Tarsus IV of ♂ of *Eberhardia pedispinifer* n. sp.
13. Tarsus IV of ♀ of *Eberhardia pedispinifer* n. sp.

OBSERVATIONS ON PARASITES OF SOME CANADIAN GRASSHOPPERS*

BY R. W. SMITH,

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An investigation of the parasites of the pest species of grasshoppers in Canada is now being carried out as a co-operative project between the Field Crop Investigations Unit of the Division of Entomology and the Parasite Laboratory of the Dominion Department of Agriculture. The purpose of the study is to determine the part played by parasites in regulating the abundance of the various grasshopper species, and it was begun in 1938 with the expectation that the information acquired might suggest the possibility of manipulating the native parasites for more satisfactory control, or indicate the desirability of introducing exotic species.

Studies on the natural control of grasshoppers in British Columbia have been carried on since 1929 by Professor G. J. Spencer of the University of British Columbia for the Field Crop Insect Investigations Unit. These investigations were carried out independently of the co-operative project begun in 1938, and the findings are not included in the present paper.

The present investigation so far has been confined largely to the Prairie Provinces, and has dealt primarily with the nymphal and adult stages of the three pest species, *Camnula pellucida* Scud., *Melanoplus mexicanus* Saus. and *Melanoplus bivittatus* Say. Some material, however, has been collected in British Columbia as well as in Ontario and other Eastern Provinces, and many additional host species have been included in the study during the past two years. The present procedure is to send to Belleville, from each collecting point, preserved material for dissection and living material for rearing. During the season of 1941 some 400 collections were made in which fifteen host species were represented. They included approximately 14,000 specimens for rearing and 14,400 for dissection.

Up to the present, seventeen species of parasites have been reared or dissected from nymphal and adult grasshoppers. Fifteen of these are primaries and two are secondaries. The primaries include fourteen species of Diptera and one mermithid species. Both the secondary species are Hymenoptera. These parasites are:

Primaries

Sarcophagidae

- Sarcophaga aculeata* Ald.
- atlanis* Ald.
- coloradensis* Ald.
- hunteri* Hough.
- kellyi* Ald.
- opifera* Coq.
- reversa* Ald.
- sinuata* Meig.

Tachinidae

- Acemya tibialis* Coq.
- Ceracia dentata* Coq.
- Hemithrixion oestriforme* B. & B.
- Leucostoma atra* Twms.

Anthomyiidae

- Acridomyia canadensis* Snyder

Nemestrinidae

- Parasymmictus clausus* O. S.

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TABLE I

List of grasshopper species collected in Canada in 1938-41 showing
parasite species obtained by dissection or rearing
(not including records of investigations in British Columbia).

Host	PARASITES															
	Sarcophaga aenescens	Sarcophaga atropis	Sarcophaga coloradensis	Sarcophaga hunteri	Sarcophaga kellyi	Sarcophaga opifera	Sarcophaga reaversi	Sarcophaga sinuata	Sarcophaga "Sarcophaga"	Acanthia tibialis	Chorebus dentatus	Hemiteles canadensis	Leptocryptus apicatus	Acanthia canadensis	Parasitocentrus clavicornis	Meritobius
Acrididae																
<i>Ageneotettix deorum</i>		X		X		X				?		?		X		X
<i>Amphitornus coloradus</i>																
<i>Camnula pellucida</i>	X	X		X					X	?		?			X	X
<i>Chorthippus longicornis</i>						X										X
<i>Scaptotilapia s. costalis</i>																X
<i>Melanoplus bivittatus</i>	X	X	X	X	X		X	X	X	X		X		X		X
<i>Melanoplus dawseni</i>		X		X			X		X	?		?				X
<i>Melanoplus foedus</i>		X		X			X		X	?		?		X		X
<i>Melanoplus f. rubrum</i>	X	X		X		X	X		X	X	X	?			X	X
<i>Melanoplus gladstoni</i>																X
<i>Melanoplus infantilis</i>																X
<i>Melanoplus mexicanus</i>	X	X	X	X		X	X		X	X	X	X	X	X	X	X
<i>Melanoplus packardii</i>		X		X			X		X	?		?		X		X
<i>Orphulella speciosa</i>																
<i>Phaenocarpa nebrascensis</i>						X										
Tettigoniidae																
<i>Conocephalus saltans</i>																X

? - This species obtained only in larval stages from dissections is
thought to be *S. coloradensis*

? - Tachinid sp. undetermined...May be this species

Mermithidae

Agamermis decaudata Cobb, Steiner, Christie

Secondaries

Perilampidae

Perilampus sp. (*hyalinus* group)

Chalcididae

Brachymeria coloradensis Cress.

Five of these species taken only from Western Canada are *S. kellyi*, *S. sinuata*, *H. oestriiforme*, *A. canadensis* and *P. clausus*. Two taken only from Eastern Canada are *C. dentata* and *L. atra*.

Above is a table (Table I) showing the parasites recorded from the various host species. Immediately following is a table (Table II) showing the localities at which the parasite species have occurred. The present records of distribution as summarized in Table II will undoubtedly be enlarged when collections are received from Saskatchewan and Alberta.

The investigation is yielding interesting information on the distribution and abundance of the various parasite species. It is also demonstrating, on the part of some host species, a definite resistance to parasite survival, and on the part of others, a considerable immunity either to parasite attack or establishment. Some parasites occur only early in the season; others occur late, and still others are present throughout the season.

Melanoplus bivittatus has shown considerable host resistance to all the sarcophagids, particularly to *S. reversa* and *S. atlantis*. Our records to date would indicate that *S. atlantis* does not survive on *M. bivittatus*. *A. canadensis* and the tachinids have fared much better in this host, with very little mortality. *M. mexicanus* has shown host resistance, apparently only to *Sarcophaga* "B" and appears to be attacked readily by most of the parasite species. *C. pellucida* is very lightly parasitized but strangely enough shows little resistance to parasite development. Whether the low parasitism in *C. pellucida* results from the inability of the parasite to penetrate the integument, or is due to protective coloration or a lack of attractiveness on the part of the host is not known at the present time.

Sarcophaga reversa and *Sarcophaga* "B" are definitely early season species and make their first appearance in early June. They attack second and later instar hosts and appear to have one and possibly a partial second generation a year. *S. hunteri* appears during the latter part of June and attacks fifth and adult instar hosts. It has at least one and possibly two generations a year. *S. atlantis* appears in late June and early July and attacks the fifth and adult instar hosts, mostly the latter. It has probably only one generation a year. The tachinids (species unseparated) occur from early June to late August, and have been found in all host instars from second to adult inclusive. They may have one or more generations a year, but since the several species have not been separated in our dissections, any overlapping that may have occurred is hidden in the records.

As a result of our studies we are now able to recognize a number of these species in their immature stages and, except in the case of the tachinids, are seldom unable to place a parasite to its proper species. For positive identification of second and third stage larvae, it is frequently necessary to locate the cast of the first larval instar. This is always present within the host, although at times extremely difficult to find. No differences have yet been found that serve to separate the four tachinid species in their immature stages, but it is probable that a more critical study of these will reveal useful characters.

In the separation of the several families and species, the most useful characters are to be found in the cephalopharyngeal sclerites, in the position and form of the spines of the body segments, and in the anterior and posterior spir-

TABLE II
List of grasshopper parasite species encountered in studies 1938-41 with place of occurrence

PARASITES	LOCALITY
<i>Sarcophaga aculeata</i>	Arnaud, Man.
<i>Sarcophaga atropis</i>	Beaudry, Man.
<i>Sarcophaga coloradensis</i>	Carnegie, Man.
<i>Sarcophaga hunteri</i>	Dominion City, Man.
<i>Sarcophaga kellyi</i>	Glenboro, Man.
<i>Sarcophaga opifera</i>	Graysville, Man.
<i>Sarcophaga revera</i>	Greenridge, Man.
<i>Sarcophaga sinuata</i>	Griswold, Man.
<i>Sarcophaga "B"</i>	Hazelridge, Man.
<i>Acarya tibialis</i>	Harding, Man.
<i>Cercia dentata</i>	Holland, Man.
<i>Hemiphysalis oestriiforme</i>	Kenton, Man.
<i>Leucostoma atris</i>	Lettonia, Man.
<i>Acridomyia canadensis</i>	Lyleton, Man.
<i>Parasymptecus clunensis</i>	McAuley, Man.
<i>Mermithidae</i>	Monominto, Man.
<i>Brachymeria coloradensis</i>	Newstead, Man.
<i>Perilampus sp.</i>	Oak Hammock, Man.
	Pilot Mound, Man.
	Ridgeville, Man.
	Riverton, Man.
	Roseau, Man.
	Souris, Man.
	Stephenfield, Man.
	Thornhill, Man.
	Tolstoi, Man.
	Uno, Man.
	Virden, Man.
	Woodmore, Man.
	Zhoda, Man.
	Belleville, Ont.
	Brighton, Ont.
	Marmora, Ont.
	Ottawa, Ont.
	Spencerville, Ont.
	Charlottetown, P.E.I.
	St. Isidore, Que.
	St. John, Que.

* - this species obtained only in larval stages from dissections is thought to be *S. coloradensis*
 * - Technidae dissected from grasshoppers collected from these points but species undetermined

acles. Additional features in the sarcophagids are to be found in the arrangement of the spines or markings on the floor of the posterior spiracular cavity. An article dealing with the immature stages of the various parasite species encountered is being prepared for publication elsewhere.

All the species so far encountered have been found in the body cavity of their host, including the head. In their younger stages they are frequently found among the muscle bands. The sarcophagid and anthomyiid larvae are free-living in all their stages. The tachinids are free-living in the first instar, but are associated with an integumental funnel in their third and possibly in their second larval instar. *Parasymmetus* has not been found in the first larval instar, but its second and third instars are associated with a long breathing tube and funnel. Professor G. J. Spencer has much unpublished information on this species as a result of his observations in British Columbia.

Field observations on the manner of parasite attack have not been made except that unidentified sarcophagids have on occasion been seen to strike at grasshoppers in flight. From laboratory observations it appears probable that *S. aculeata* deposits its first instar larvae on hosts when they are in flight, and this method of larviposition is probably used by other sarcophagids. In cages, both *S. hunteri* and *S. atlanis* have been observed stalking their victims, and *S. hunteri* has been seen inserting chorion-enclosed larvae in the folds between the abdominal segments of a prospective host. In the case of *S. reversa* and *S. coloradensis*, first instar larvae are most prevalent in the nymphal stages of their hosts, and it is not known how these hosts are attacked while still in their pre-flight stages. As for the tachinids, a single gravid female of *Hemithrixion oestriforme* was found to contain microtype eggs, and from this it appears likely that the eggs are deposited on foliage and hatch when ingested by a suitable host. Townsend (Myiology, IV) has indicated that this group deposits its eggs directly upon the host. Further study may show Townsend to be correct. The anthomyiid, *Acridomyia canadensis* has a unique manner of oviposition. After making a feeding puncture in the host with its mouth parts, usually at the base of the legs or on the abdominal segments, it inserts the tip of the ovipositor in this same puncture and deposits its eggs. As many as forty-eight larvae of this species have been found in one host.

The secondary parasite, *Perilampus* sp. deposits its eggs on foliage. These hatch into active larvae which eventually attach themselves to their secondary hosts and enter through the integument.

Four species of sarcophagids, *S. atlanis*, *S. hunteri*, *S. reversa* and *S. aculeata* which have been propagated in the laboratory have, at 75° F., a prelarviposition period of about 6 days and a larval period of about 5 to 14 days. Individuals that do not enter diapause have a pupal period of from 14 to 16 days. *S. aculeata* and *S. reversa*, however, frequently enter diapause in the mature larval stage and require a hibernation period before their development can be completed. There appears to be a slight variation in the time required for development on the different host species, but the records are not sufficiently extensive to permit definite statements on this feature at the present time.

ACKNOWLEDGEMENTS

The field work of the present investigations in Manitoba has been carried on by Dr. R. D. Bird of the Brandon laboratory and his staff, including Dr. R. H. Handford, D. S. Smith, W. R. Allen, and H. W. Moore. Outside of Manitoba collections have been sent in by E. R. Buckell, Kamloops, B. C., R. M. White, Lethbridge, Alta., Dr. L. C. Paul, V. L. Berg and L. G. Putnam, Saskatoon, and P. C. Brown, Estevan, Sask. Eastern collections have been sent in by H. G. Crawford and A. G. Dustan, Ottawa, and C. H. Hammond, Marmora, Ont., J. B. Maltais, St. Jean, Que., and F. M. Cannon, Charlottetown, P. E. I. Assistance has been given by D. Price, T. Burnett, W. Wellington, H. James, G. Wish-

art and Mrs. T. Finlayson. Particularly significant contributions to the present investigations must be credited to members of the Field Crop Insect Investigations Unit, who prepared memoranda covering records of the occurrence in their respective territories, up to 1937, of grasshopper parasites, predators and disease organisms. These memoranda were prepared as a preliminary to the exchange of grasshopper parasite material with Argentina, and it was largely as a result of these resumé and the collection of parasitic material that the present investigation was started. The officers concerned were E. R. Buckell, and G. J. Spencer, Kamloops, B. C., H. L. Seamans, Lethbridge, Alta., Dr. K. M. King, Saskatoon, Sask., and Dr. R. D. Bird, Brandon, Manitoba.

A REVISION OF THE GENUS *CHLOROSEA* PACK., WITH
DESCRIPTIONS OF NEW SPECIES (LEPIDOPTERA,
GEOMETRIDAE)

BY JOHN L. SPERRY,

Riverside, California

Two years ago, while collecting original descriptions of the geometrid moths, the author stumbled on an apparent discrepancy in Packard's original description of *Chlorosea nevadaria* (Proc. Bost. Soc. Nat. Hist., 16:31, 1874), and in the later description of the same species in his *Monograph* (p. 378, 1876). It then occurred to the author that this discrepancy might well explain our difficulties in attempting to identify this western species, and trips to the Museum of Comparative Zoology in 1940 and 1941 confirmed this amply.

Chlorosea nevadaria Pack. was originally described from specimens labelled "Nevada, Edwards", evidently relaxed specimens, somewhat worn; the description is good, except that the line on the secondaries is apparent in the type specimens. Evidently Packard received more specimens which he considered referable to this species very shortly thereafter, most of these coming from the northern Pacific coast, and in preparing his *Monograph* he deemed it necessary to rewrite the description to include these specimens.

In 1911 Pearsall described *Chlorosea proutaria* from Chimney Gulch, Golden, Colo., and Eureka, Utah (Can. Ent., 43:250), and in 1912 Prout described *Chlorosea roseitacta* from Palmerlee, Ariz., (Gen. Ins., Fasc. 129, 116). These three species make up the genus *Chlorosea* as it stands, as of the last check list (McDunnough, 1938), but as it would seem that there are certain stable differences between the Nevada and the Pacific Coast specimens which have been referred to Packard's *nevadaria*, and as there is still another species commonly taken on the east slope of the southern part of the Sierra Nevada Mountains in California and commonly confused with *nevadaria* Pack., it may perhaps be profitable to review the whole genus. In this connection and in order to clarify the *nevadaria* situation, it seems desirable to quote Packard's two descriptions in full.

The genus *Chlorosea* was erected by Packard (Proc. Bost. Soc. Nat. Hist., 16:31, 1874) for the single species *nevadaria*. His description compares *Chlorosea* with *Nemoria*, *Eunemoria*, *Phorodesma* and *Pseudoterpna* and stress the moderately long, slender palpi, male antennae pectinated nearly to the tip, broad wings, unusually small hind legs, and the short tibiae armed with a single pair of spurs only.

In 1896 Hulst (Trans. Am. Ent. Soc., 23:315) published a concise description as follows: "Palpi scaled, not heavy, subascending; clypeus flat, with a tendency to a scale ridge below; antennae bipectinate in the male, ciliate in the female; thorax and abdomen untufted; fore tibiae unarmed, hind tibiae

with one pair of spurs in both sexes; fore wings even, no accessory cell, 12 veins, 3 and 4 from angle, 6 from a point or short stemmed with 7, 10 or 9, 11 from cell, 12 separate. Hind wings, 8 veins, 3 and 4 from angle, 6 and 7 stemmed, 8 separate from cell."

Prout (Gen. Ins., Fasc. 129, 116, 1912), whose generic descriptions leave little to be desired, corrected Hulst's description as follows: "... tongue present, slender ... female antennae shortly serrate, dentate, abdomen slightly crested ... Frenulum present in both sexes ... forewing, 12 anastomosing with 11 (it occurs both ways) ... hindwing, 8 approximate to cell for some distance" (or separate from cell as Hulst states).

The only genus whose species seem to find their way into *Chlorosea* series is *Merochlora* Prout, and its description calls for two pairs of spurs on the hind tibiae and for the frenulum lacking in both sexes.

As to *Chlorosea nevadaria* the following is Packard's description, the controversial points being italicized.

"*Chlorosea Nevadaria* n. sp. 1 ♂, 2 ♀.

"Pale pea green. Head whitish at the insertion of the antennae (which are white above), but greenish on the hinder edge of vertex; front pale greenish pink on the orbits; palpi whitish; thorax green; *abdomen white*. Both wings pale green; fore wings whitish on extreme edge of costa; an oblique, rather broad band, straight in its course, crosses the wing from just beyond the middle of the inner edge to the outer fifth of the costa; it is situated nearer the outer edge in the ♀. No other markings. Hind wings slightly paler than primaries, *with no markings*. Beneath uniformly pale green, hind wings a little paler than primaries. Legs whitish, two anterior pairs of tibiae pink.

"Length of body ♂, .55, ♀, .45-.50 inch; fore wings, ♂, .70, ♀, .60-.68 inch. Nevada (Edwards).

"The smaller of the two ♀ has paler hind wings, and an entirely reddish front. The species may be recognized by the large size, *the want of any markings on the hind wings*, and by the very slender hind legs with the single pair of tibial spurs."

This is a very fair description of the three specimens from Nevada which bear type labels in the Museum of Comparative Zoology. However, there is a line on the secondaries that is apparent though faint. The description in the *Monograph*, however, is "something else again". It follows.

"*Chlorosea nevadaria* Pack., Proc. Bost. Soc. Nat. Hist., XVI, 31, 1874.

"2 ♂ and 5 ♀. Pale pea-green. Head whitish at the insertion of the antennae (which are white above), but greenish on the hinder edge of vertex; front pale greenish, pink on the orbits, or entirely pink. Palpi whitish; thorax green. Both wings pale green, *coarsely and diffusely strigated with white*. Fore wings whitish on extreme edge of costa; an oblique rather broad band, straight in its course, crosses the wing from just beyond the middle of the inner edge to the outer fifth of the costa; it is situated nearer the outer edge in the ♀. No other markings. Hind wings slightly paler than the primaries, *with a white line just beyond the middle, broader and less distinct than on the fore wings*. Beneath uniformly pale green; hind wings a little paler than primaries; faint traces of the lines on the fore wings. Legs whitish; two anterior pairs of tibiae pink. *Abdomen white, tinged with pinkish at the base with two conspicuous round spots, having an irregular v-shaped, pink spot between them and another behind*.

"Nevada, (Edwards); Victoria, Vancouver Island, (Crotch, Mus. Comp. Zool.); Southern California (U. S. Dept. Agriculture); Sanzilito, Cal., June 2-7 (Behrens).

"The species may be recognized by its large size, *the single line common to both wings, by white and pink spotted abdomen*, and by the very slender hind legs with the single pair of tibial spurs."



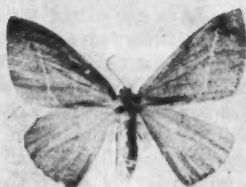
nevadaria, Pack.



proutaria, Pears.



margaretaria, sp.n.



banksaria, sp.n.



roseitacta, Prout

SPECIES OF *CHLOROSEA* PACK.

Now it is readily seen that Packard had received four more specimens, and he has given us the localities of these captures, all of which were made near the Pacific Coast. As may be seen by examination of the two descriptions, these West Coast specimens were larger, were coarsely and diffusely strigated with white, and had conspicuous pinkish dorsal spots on the first three segments of the abdomen. The Pacific Coast *Chlorosea* is rather common, and I have been able to examine long series of these pink-spotted insects; they run very true to form throughout. The original *nevadaria* as described from "Nevada", however is a much rarer insect; it has taken the author eight years to collect three specimens and only ten have been examined in all. The abdomen in all ten specimens is a very light green or white without dorsal spots of any kind. The course of the lines on both wings is also very constant, in this respect being almost like specimens from the West Coast; the width of the lines, however, is about twice that of the West Coast specimens (0.50 mm. as compared to 0.25 mm.), and the wings of *nevadaria* are less strigated with white.

Chlorosea banksaria n. sp.

With the above observations in mind it would seem proper to consider the types of *nevadaria* the three specimens originally used by Packard in describing the species. This leaves the West Coast species, with the dorsal pinkish abdominal spots as a distinguishing character, without a name. For this species the author proposes the name *banksaria* in honor of Dr. Nathan Banks of the Museum of Comparative Zoology, whose kindly courtesy and ready understanding have made it possible to straighten the tangled threads of this genus.

Holotype—♂, Puyallup, Wash., July 26, 1939 (S. E. Crumb), in the Museum of Comparative Zoology, Cambridge, Mass.

Allotype—♀, Inverness, Marin Co., Calif., June 10, 1940 (W. R. Bauer); No. 5260 in the Canadian National Collection, Ottawa.

Paratypes—It has seemed wise to designate a fairly large series as paratypes and to distribute these rather widely, which has been done as follows.

In the Museum of Comparative Zoology, Cambridge, Mass.: 1 ♀, Top of Mt. Wilson, Calif., July 11, 1913 (H. H. Newcomb); 1 ♀, Victoria, B. C. (Crotch); 2 ♀, Modoc Co., Calif., July 11 and 14 (S. E. Cassino).

In the Canadian National Collection, Ottawa: 1 ♀, Half Moon Bay, Calif., July 8, 1937 (W. H. Lange).

In the U. S. National Museum, Washington, D. C.: 3 ♂, 1 ♀, Shasta Retreat, Siskiyou Co., Calif., July 1-7; 1 ♂, 9 ♀, Camp Baldy, San Bernardino Mts., Calif., June 21-Aug. 15; 1 ♂, Deer Park Springs, L. Tahoe, Calif., July 1-7; 1 ♂, Wash. Terr. (B. Neumogen); 1 ♂, Seattle, Wash. (O. B. Johnson); 1 ♂, 1 ♀, June 11, 1900 (G. W. Taylor); 1 ♂, Goldstream, B. C., July 11, 1923 (J. F. G. Clarke); 1 ♀, Monterey Co., Calif.; 1 ♀, Oakland, Calif., June 11, 1908 (G. R. Pilate); 1 ♀, Puyallup, Wash., July 13, 1938 (J. F. G. Clarke); 1 ♀, Vancouver Island, B. C., July 22, 1912 (Hanham).

In the Los Angeles County Museum of History, Science and Art: 1 ♂, Roscoe, Los Angeles Co., Calif., May 1, 1930 (Lloyd Martin); 1 ♂, Roscoe, Los Angeles Co., Calif., May 13, 1930 (R. H. Andrews).

In the San Diego Museum of Natural History: 1 ♂, Laguna, San Diego Co., Calif., June 23, 1926 (W. S. Wright); 1 ♀, Shasta Co., Calif., June, 1903 (F. X. Williams); 1 ♀, San Diego, Calif.; 1 ♀, no data.

In the collection of Otto Buchholz, Roselle Park, N. J.: 1 ♂, Bartle, Siskiyou Co., Calif., July 18, 1936 (E. C. Johnston); 2 ♂, 2 ♀, Santa Monica, Calif., May-June; 1 ♀, Camp Baldy, San Bernardino Mts., Calif., July; 1 ♂, 2 ♀, no data.

In the collection of Fred Ringe, La Sierra Heights, Calif.: 2 ♀, Smith Lake, Plumas Co., Calif., July 17, 1941.

In the collection of Grace H. and John L. Sperry, Riverside, Calif.: 1 ♂, Mt. Wilson, Calif., Aug. 9, 1913 (H. H. Newcomb); 1 ♂, Bartle, Siskiyou Co., Calif., July 18, 1936 (E. C. Johnston); 1 ♀, L. Arrowhead, San Bernardino Co., Calif., May 30, 1937 (H. C. Little); 1 ♀, Dunsmuir, Calif., and 1 ♀, Castella, Calif., June 11 and 13, 1939 (Sperry); 2 ♀, Carrville, Trinity Co., Calif., June 25, July 1 (Bauer); 2 ♀, Inverness, Marin Co., Calif., June 10, 1940 (Bauer); 1 ♀, Spring Mt., Napa Co., Calif., June 3, 1940 (Bauer); 1 ♀, Lakeshore (7000 ft.) Fresno Co., Calif., July 10, 1940 (Ringe).

In the collection of the California Academy of Sciences, San Francisco: 3 ♂, Carrville, Trinity Co., Calif., May 21-June 17 (E. C. Van Dyke); 2 ♂, Huntington Lake, Fresno Co., Calif., June 9 and 21, 1919 (E. P. Van Duzee); 1 ♂, 2 ♀, Shasta Co., Calif., June, 1903 (F. X. Williams); 1 ♂, Paraiso Sprs., Calif., Sept. 28, 1933 (L. S. Slevin); 16 ♀, Carmel, Calif., Mar. 6-July 1, 1933 (L. S. Slevin); 1 ♀, San Antonio Canyon, Calif., July, 1929 (T. Craig); 1 ♀, Santa Cruz, Calif., July 5, 1934 (E. A. Dodge); 1 ♀, Mt. St. Helens, Napa Co., Calif., June 9, 1918 (E. P. Van Duzee); 1 ♀, Glen Alpine Cr., El Dorado Co., Calif., July 18, 1909 (F. X. Williams).

In the collection of E. C. Johnston of Seattle, Wash.: 1 ♂, Bartle, Siskiyou Co., Calif., June 18, 1936 (E. C. Johnston); 1 ♀, The Geysers, Sonoma Co., Calif., June 21, 1938 (E. C. Johnston).

Some of the specimens of *banksaria* from the southern part of the range seem smaller than is typical, have a tendency toward obsolescence in the line on the forewing, and occasionally have a small pink 'V' on the fourth segment of the abdomen; genitalic differences, however, are too slight to warrant their separation from *banksaria*.

In his description of *Chlorosea proutaria*, Pearsall states: "In appearance, much like *nevadaria* Packard but easily distinguished from it by the absence of red markings on the abdomen." If this were the only difference, the species would become a synonym of *nevadaria*, but there are other distinguishing features. The green of the primaries is more intense than in either *nevadaria* or *banksaria*. As Pearsall states, the lines are very nearly the same in direction as in *nevadaria* but reach the inner margin slightly nearer the base; in width the lines are much narrower than in *nevadaria* but slightly wider than in *banksaria*. *C. proutaria* is a smaller insect than *nevadaria*, the expanse being from 32 to 34 mm., as compared with 33 to 35 mm. in *nevadaria* and 33 to 36 mm. in *banksaria*. There are also good genitalic differences as will be shown later.

Chlorosea margaretaria n. sp.

On the southeast slope of the Sierra Nevada Range of California, between the Walker River and the Argus Mountains, we find still another *Chlorosea* which is smaller than any of the preceding and which shows a marked difference in the direction of the line on the forewings. It may be described as follows.

Palpi moderate, white below, tinged with pink laterally, white dorsally; head, front and vertex white, a pinkish tinge surrounds the eyes; antennae yellowish, shaft white, male short pectinated, female serrate-dentate; thorax green above and below, abdomen green at base, becoming white toward tip above and below. Legs: all femora green; fore and mid tibiae tinged with pink inwardly; hind tibiae white. Forewings of a darker green than the three aforementioned species, without trace of the white strigations which mark the others. Costa white. The single line white, heavy, starting at right angles to the costa 1 to 1½ mm. from the apex, straight to vein 7; the line to this point narrow (less than ¼ mm., in many specimens entirely or partially obsolete); below vein 7 it curves sharply and widens perceptibly inwardly to nearly ¾ mm., then runs nearly straight to the inner margin which it reaches near or just inside

the middle. This line starts at the costa 2 mm. nearer the apex than in any other of the known species of *Chlorosea* and reaches the inner margin closer to the base than in any other species. It offers the best determining characteristic of the species. Fringe white, in fresh specimens with a narrow green basal line slightly darker than the ground color. Secondaries lighter than the primaries; with a single, $\frac{3}{4}$ mm., white line starting just beyond the middle of the inner margin, curving gently toward apex to vein 6, then sharply inward toward center of costa, and disappearing in the ground color immediately thereafter; the area basad of this line is nearly white, with a very thin speckling of green scales; the area distad of this line is much more heavily clouded with green.

Beneath: Both wings lighter green, the areas on both approximate to the inner margins nearly white; in some specimens the costa has a tinge of very dull rose; lines of upper surface showing dimly through.

Female somewhat larger than the male and the lines more evenly curved but in the same location. Expanse: male, 28-30 mm.; female, 30-32 mm.

Holotype—♂, Lundy Creek, Mono Co., Calif., July 11, 1937 (Lloyd Martin); No. 5259 in the Canadian National Collection, Ottawa.

Allotype—♀, Casa Diablo Hot Springs, Mono Co., Calif., Aug. 5, 1938 (Grace H. and John L. Sperry); in the Sperry Collection.

Paratypes—In the Canadian National Collection, Ottawa: 1 ♂, Mammoth Camp, Mono Co., Calif., July 23, 1933; 1 ♂, Levining, Calif. (E. C. Johnston); 1 ♀, Round Valley, Inyo Co., Calif., Aug. 4-8, 1929 (J. A. Comstock).

In the U. S. National Museum, Washington, D. C.: 1 ♂, Argus Mts., Inyo Co., Calif., May 6, 1934 (Walton); 2 ♀, Walker River, Mono Co., Calif., June 8 1932.

In the Museum of Comparative Zoology, Cambridge, Mass.: 1 ♂, Argus Mts., Inyo Co., Calif., May 13, 1935 (M. L. Walton).

In the San Diego Museum of Natural History: 1 ♂, Argus Mts., Inyo Co., Calif., May 13, 1935 (M. L. Walton).

In the Los Angeles County Museum: 10 ♂, Lundy Cr., Mono Co., Calif., July 11, 1937, 1 ♂, July 26, 1936 (Martin); 19 ♂, 2 ♀, Argus Mts. Inyo Co., Calif., May 9-27 (Walton and Martin); 1 ♂, 1 ♀, near Topaz, Calif., July 15, 1937 (J. A. Comstock); 1 ♀, Virginia Lakes, Mono Co., Calif., July 11, 1933 (J. A. Comstock); 1 ♀, Mammoth Camp, Mono Co., Calif., Aug. 6, 1939 (W. D. Pierce); 1 ♂, 1 ♀, Mammoth Lake, Mono Co., Calif., July 23, 1933; 1 ♀, Walker R., Mono Co., Calif., June 8, 1932.

In the Collection of Grace H. and John L. Sperry: 3 ♂, Argus Mts., Inyo Co., Calif., May 13, 1935 and May 23, 1936; 1 ♂, Lundy Cr., Mono Co., Calif., June 11, 1937 (Lloyd Martin); 2 ♀, Round Valley, Inyo Co., Calif., Aug. 4-8 (J. A. Comstock); 1 ♀, Casa Diablo Hot Springs, Mono Co., Calif., Aug. 6, 1938 (Sperry).

In the collection of Otto Buchholz, Roselle Park, N. J.: 1 ♂, Lundy Cr., Mono Co., Calif., July 11, 1937 (Lloyd Martin).

In the collection of E. C. Johnston, Seattle, Wash.: 1 ♂, Levining, Mono Co., Calif., July 19, 1938 (E. C. Johnston).

It gives me great pleasure to name this beautiful species in honor of Mrs. James McDunnough of Ottawa, whose flying fingers I have often envied and whose kindly advice has, I hope, improved the looks of our collection.

There remains *Chlorosea roseitacta* Prout, the smallest member of the genus which is taken sparingly throughout Arizona. The wings are darker green than in the others; the lines are narrower than in others of the group, and the rosy streak on the inner margin of the hind wing makes the species rather easily identifiable. The abdomen has dorsal pink spots on the first four segments.

The species may then be arranged as follows.

Chlorosea Packard—Genotype: *nevadaria* Packard

margaretaria n. sp.
nevadaria Packard
proutaria Pearsall
banksaria n. sp.
roseitacta Prout

Margaretaria, *nevadaria*, and *proutaria* have unspotted abdomens. *Banksaria* and *roseitacta* have white or yellow spots marked with pink, dorsally, on the first three or four segments of the abdomen; the pink mark on the first segment is shaped like a horseshoe open toward the thorax; on the second, third, and sometimes on the fourth segment, it is shaped like a 'V' with its point toward the thorax; usually the pink mark on the fourth segment and occasionally that on the first segment is missing. *Margaretaria* and *nevadaria* have broad lines of different shapes; the wings of *nevadaria* are strigate with fine white, irregular, vertical lines; *margaretaria* is not strigated. *Proutaria* is smaller than *nevadaria*, with narrower lines and more intense coloring, though the direction of the lines is nearly the same. *Roseitacta* is readily separated from *banksaria* by reason of the rosy streak on the inner margin of the hind wing.

Genitalia of the members of the genus are very similar, offering, however, several good separating characters. Male genitalia are of a simple type, with the claspers moderately long, not very broad, with a shoulder from below and behind the costal edge bearing a tooth at its apex; uncus very long, narrow, spoon-shaped; gnathos well developed; juxta somewhat narrow, aedoeagus bulbous, its apex drawn to a blunt point, unspined; anal plate simple, scallop v-shaped; dorsal edge of eighth segment scobinate, with short sharp teeth.

In *nevadaria* and *proutaria* the uncus appears bifurcate at the tip, somewhat more deeply so in *proutaria*; in the other three species it is simple. The gnathos at tip is rounded in *nevadaria*, *banksaria* and *roseitacta*, blunt in *proutaria*, and very thin and sharp in *margaretaria*. The costal shoulder is somewhat different in each species; in *banksaria* the tooth is long and sharp and the center of the shoulder is shaped like a flat tooth. The other species have smoothly curved shoulders. In *roseitacta* there are two tiny cornuti at the apex of the costa near the foot of the tooth. The aedoeagus shows little of value. The anal plates show differences in all five species; in *proutaria* the depression is narrow and deep, in *margaretaria* shallow and broad. The decorative teeth on the edge of the eighth segment, differing in four of the five species, are wanting in *roseitacta*, single in *margaretaria*, double in *nevadaria*, and multiple in *proutaria* and *banksaria*.

In the female the ductus bursae is long and very narrow in *nevadaria* and *roseitacta*, much broader in the other three species, undecorated in all. The bursa copulatrix is far up in the abdomen in all species; in *nevadaria* the bursa is ovoid, in *roseitacta* like the driver from the golf club bag, in the other three species irregularly pear shaped. The signum is indicated in *nevadaria* by a hair-lined oval, in *roseitacta* by a small, more heavily marked oval, in *banksaria* and *proutaria* by dark dots, and in *margaretaria* is unmarked as far as I can see.

In conclusion I wish to thank the many friends who have lent their specimens, their time, and their advice to make this paper possible; without the help of Dr. McDunnough, of Ottawa, Dr. Banks and Dr. Barbour of the Museum of Comparative Zoology, Dr. Comstock, Lloyd Martin and Chris Henne of the Los Angeles Museum, Hahn Capps of the U. S. National Museum, Dr. Abbott of San Diego, Dr. Miller of the California Academy of Sciences, and my good friends Otto Buchholz, Fred Ringe and E. C. Johnston, it would have been difficult if not impossible to assemble sufficiently representative series to make a revision of this genus worth while.

A LIST OF HEMIPTERA TAKEN AT HUDSON HEIGHTS, QUEBEC.

BY GEO. A. MOORE,

Outremont, Quebec

The following is a list of Hemiptera taken at Hudson Heights, Quebec, during the seasons of 1941 and 1942 between June 7 and September 21. Hudson Heights is located on the Ottawa River approximately nine miles west of where that river meets the St. Lawrence River, and approximately 80 miles east of Ottawa.

The list includes 237 species of the suborder Heteroptera and 218 species of the suborder Homoptera, a total of 455 species, and adds the names of many species not previously recorded in the fauna of the Province of Quebec.

SUBORDER HETEROPTERA

SCUTELLERIDAE

Homaemus aeneifrons Say
Eurygaster alternatus Say

CYDNIDAE

Galgupha atra A. & S.
nitiduloides Wolff
Corimelaena pulicaria Germ.
Amnestus pusillus Uhl.
Sehirus cinctus P. B.

PENTATOMIDAE

Brochymena quadripustulata Fabr.
Peribalus limbolarius Stal.
Mormidea lugens Fabr.
Euschistus euschistoides Voll.
tristigmus Say
variolaris P. B.
Coenus delius Say
Neottiglossa undata Say
Cosmopepla bimaculata Thom.
Acrosternum hilaris Say
Banasa dimidiata Say
Meadorus lateralis Say
Elasmostethus cruciatus Say
atricornis V. D.
Perillus bioculatus Fabr.
Podisus maculiventris Say
modestus Dall.
placidus Uhl.

COREIDAE

Anasa armigera Say

ALYDIDAE

Protenor beltragei Hagld.
Alydus eurus Say
conspersus Montd.

CORIZIDAE

Stictopleurus crassicornis Linn.
bohemani Sign.

ARADIDAE

Aneurus inconstans Uhl.

NEIDIDAE

Neides muticus Say

LYGAEDIDAE

Lygaeus kalmii Stal.
Ortholomus scolopax Say
Nysius thymi Wolff
ericae Schill.
Ischnorrhynchus geminatus Say
Cymus augustatus Stal.
discors Horv.
luridus Stal.
Blissus leucopterus Say
Geocoris bullatus Say
var. floridanus Blat.
uliginosus Say
var. limbatus Stal.
Phylegias abbreviatus Uhl.
Oedancala dorsalis Say
Crophius disconotus Say
Heraeus plebejus Stal.
Ligyrocoris sylvestris Linn.
diffusus Uhl.
Perigenes constrictus Say
Zeridoneus costalis V. D.
Orthaea basalis Dall.
Ptochiomera ferruginea Stal.
Antilloecoris pallidus Uhl.
Stignocoris pedestris Fall.
rusticus Fall.
Spragisticus nebulosus Fall.
Drymus unus Say
Eremocoris ferus Say
Scolopostethus thomsoni Reut.

PIESMIDAE

Piesma cinerea Say

TINGITIDAE

Acalypta lillianis Bno.
Corythucha arcuata Say
ulmi O. & D.
pergandei Heid.
marmorata Uhl.
juglandis Fh.
mollicula O. & D.
pallipes Parsh.
Gargaphia tiliae Walsh
Physatocheila variegata Parsh.
brevirostris O. & D.
Leptopypha mutica Say

PHYMATIDAE

Phymata erosa wolffi Stal

REDUVIIDAE

Empicoris errabundus Say
Reduvius personatus Linn.
Zelus exsanguis Stal
Sinea diadema Fabr.

MESOVELIIDAE

Mesovelia mulsanti White

NABIDAE

Pagasa fusca Stein
Nabis subcoleoptratus Kby.
propinquus Reut.
limbatus Dahlb.
ferus Linn.
roseipennis Reut.
rufusculus Reut.

CIMICIDAE

Cimex lectularius Linn.

ANTHOCORIDAE

Lasiophilus fuscus Reut.
Xylocoris sordidus Reut.
Asthenidea temnostethoides Reut.
Anthocoris borealis Dall.
Orius insidiosus Say
var. tristicolor White
Macrotrachelia nigra Parsh.

MIRIDAE

Phytocoris buenoi Knt.
diversus Knt.
erectus V. D.
eximius Reut.
fulvus Knt.
Phytocoris lasiomerus Reut.
minutulus Reut.
neglectus Knt.
onustus V. D.
pallidicornis Reut.
salicis Knt.
spicatus Knt.
tibialis Reut.
Neurocolpus nubilus Say
Paracalacoris colon Say
scrupeus Say
Stenotus binotatus Fabr.
Adelphocoris rapidus Say
Horcias dislocatus Say
var. goniphorus Say
var. limbatellus Walk.
var. nigrinus Reut.
Poecilocapsus lineatus Fabr.
Polymerus unifasciatus Fabr.
Polymerus unifasciatus Fabr.
venaticus Uhl.
Dichroscytus suspectus Reut.
viridicans Knt.
Lygus pabulinus Linn.
lucorum Meyer
oblineatus Say
var. strigulatus Walk.
var. rubidus Knt.
rubicundus Fall.
vanduzeei Knt.
var. rubroclarus Knt.

Neolygus alni Knt.

atritylus Knt.
bellfragii Reut.
canadensis Knt.
communis Knt.
confusus Knt.
hirticulus V. D.
omnivagus Knt.
tiliae Knt.
vitticollis Reut.
Lygidea obscura Reut.
rosacea Reut.
salicis Knt.
Neoborus amoenus Reut.
var. signatus Reut.
canadensis V. D.
Capsus ater Linn.
var. tyrannus Fabr.
var. semiflavus Linn.
Platytyellus borealis Knt.
nigrocollis Reut.
rubellicollis Knt.
var. confluentis Knt.
var. vittiscutis Knt.
Stenodema trispinosum Reut.
vicinum Prov.
Trigonotylus ruficornis Geoff.
Miris dolobratrus Linn.
ferrugatus Fall.
Collaria meillerii Prov.
oculata Reut.
Mimoceps insignis Uhl.
Megaloceroea recticornis Geoff.
Pilophorus amoenus Uhl.
clavatus Linn.
Ceratocapsus drakei Knt.
modestus Uhl.
pumilus Uhl.
Noctuocoris fumidus V. D.
Orthotylus chlorionis Say
concolor V. D.
cruciatus V. D.
dorsalis Prov.
modestus V. D.
var. immaculatus Knt.
neglectus Knt.
ulmi Knt.
Melanotrachus flavosparsus Sahlb.
Mecomma gilvipes Stal.
Diaphnida capitata V. D.
pellucida Uhl.
provancheri Burque
Lopidea cuneata V.D.
instabilis Reut.
media Say
Ilmacora malina Uhl.
Labops hesperius Uhl.
Strongylororis stygicus Say
atritibialis Knt.
Halticus apterus Linn.
bracteatus Say
Deraeocoris nebulosus Uhl.
poecilus McA.
aphidiphagus Knt.
borealis V.D.
fasciolus Knt.
var. castus Knt.
nitenatus Knt.
Fulvius brunneus Prov.

Monalocoris filicis Linn.
Sixeonotus insignis Reut.
Hyaliodes vitripennis Say
Dicyphus agilis Uhl.
 jamelicus Uhl.
Lopus decolor Fall.
Criocoris saliens Reut.
Lepidopsallus rubidus Uhl.
 var. atricolor Knt.
Psallus piceicola Knt.
Microphylellus elongatus Knt.
 longirostris Knt.
 tsugae Knt.
Rhinocapsus vanduzeei Uhl.
Plagiognathus albonotatus Knt.
 var. compar Knit.
 alboradialis Knt.
 atricornis Knt.
 brevirostris Knt.
 caryae Knt.
 chrysanthemi Wolff
 cornicola Knt.
 cuneatus Knt.
 nigritus Knt.
 nigronitens Knt.
 obscurus var. albocuneatus Knt.

politus Uhl.
 var. flaveolus Knt.
 repetitus Knt.
 salicicola Knt.
 suffuscapennis Knt.
Chalmydatus associatus Uhl.
 pulicarius Fall.
Campylomma verbasci Meyer

CRYPTOSTEMATIDAE

Ceratocombus vagans McA. & Mall.

GERRIDAE

Gerris nyctalis D. & H.
 marginatus Say
 buenoi Kirk.
 dissortus D. & H.

VELIIDAE

Microvelia americana Uhl.
Rhagovelia obesa Uhl.

SALDIDAE

Saldula confluenta Say
 interstitialis Say
 opacula Zett.
 saltatoria Linn.
 pallipes Fabr.
Micracanthia humilis Say

NOTONECTIDAE

Notonecta undulata Say
Plea striola Fieb.

NEPIDAE

Ranatra fusca P. B.

BELOSTOMATIDAE

Lethocerus americanus Leidy
Belostoma flumineum Say

CORIXIDAE

Aretocorixa alternata Say
 atopodonta Hung.
Callicorixa canadensis Walley

Suborder HOMOPTERA

CICADIDAE

Tibicen canicularis Harr.

CERCOPIDAE

Aphrophora quadrinotata Say
 savatogensis Fh.
Lepyronia quadrangularis Say
Philaenus leucophthalmus Linn.
 var. leucocephalus Linn.
 var. ustulatus Fall.
 var. pallidus Zett.
 lineatus Linn.
Clastoptera obtusa Say
 var. borealis Ball
 var. tristis V.D.
 proteus Fh.
 var. saint-cyri Prov.
 var. nigrocollis Fh.
 var. osceola Ball

MEMBRACIDAE

Ceresa diceros Say
 bubalus Fabr.
 taurina Fh.
 palmeri V. D.
 borealis Fairm.
 basalis Walk.
 brevicornis Fh.
Acutalis nigronevris Fow.
Microtalis dorsalis Fh.
Carynota porphyrea Fairm.
Glossonotus nimbatus Ball
 univittatus Harr.
Telemona obsoleta Ball
 reclivata Fh.
Archasia belfragei Stal.
Cyrtolobus maculifrons Emm.
 vau Say
Azymna querci Fh.
Ophiderma salamandra Fairm.
 flavicephala Godg.
 flava Godg.
 pubescens Emm.
Entylia bactriana Germ.
 sinuata Fabr.
Pubilia concava Say
Campylenchia latipes Say
Enchenopa binotata Say

CICADELLIDAE

Agalliopsis novella Say
Agallia quadripunctata Prov.
Acertagallia sanguinolenta Prov.
Idiocerus nervatus V. D.
 pallidus Fh.
 saturalis Fh.
 var. lunaris Ball
 duszei Prov.
 alternatus Fh.
 lachrymalis Fh.

- crataegi* V. D.
provancheri V. D.
Macropsis virescens Gmel.
 var. graminea Fab.
 viridis Fh.
 suturalis O. & B.
 sordida V. D.
 canadensis V. D.
 ferrugineoides V. D.
 nigricans V. D.
 robusta Break.
 basalis V. D.
 fumipennis G. & B.
 var. gleditschiae O. & B.
 trimaculata Fh.
 insignis V. D.
Oncopsis variabilis Fh.
 sobrius Walk.
 cognatus V. D.
 fitchi V. D.
 pruni Prov.
 nigrinasi Fh.
Oncometopia lateralis Fabr.
Cicadella gothica Sign.
Kolla bifida Say
Helochara communis Fh.
Graphacephala coccinea Forst.
Draeculacephala paludosa Ball & China
 mollipes Say
 angulifera Walk.
 var. manitobiana Ball
 prasina Walk.
 minor Walk.
Evacanthus acuminatus Fabr.
Gyponana cana Burm.
 striata Burm.
Ponana pectoralis Spang.
 puncticollis Spang.
Strongylocephalus agrestes Fall.
Acucephalus nervosus Schk.
 fusco-fasciatus Goeze
 flavostrigatus Donov.
 albifrons Linn.
Xestocephalus pulicarius V.D.
 brunneus V.D.
Parabolocyratus major Osb.
Bandara johnsoni V.D.
Scaphoideus productus Osb.
 immistus Say
 ochraceous Osb.
 melanotus Osb.
 opalinus Osb.
Osbornellus auronitens Prov.
 scalaris V. D.
Prescottia lobatus V. D.
Platymetopius vitellinus Fh.
Platymoideus acutus Say
 cuprescens Osb.
 latus Bak.
Latulus configuratus Uhl.
 ocellaris Fall.
 sayi Fh.
 miscellus Ball
Polyamia apicatus Osb.
 inimicus Say
Laevicephalus melsheimerii Fh.
 unicoloratus G. & B.
 pascuellus Fall.
 spicatus Del.
Amplicephalus osborni V.D.
Amphipyga acuticauda Bak.
Drylix striolus Fall.
 parallelus V.D.
Euscelis extrusus V.D.
 sahlbergi *var. deceptus* S & Del.
 relativus G. & B.
Ophiola anthracina V.D.
 arctostaphyli Ball
 cornicula Marsh.
 luteola Slees.
Commellus coma V.D.
Amblysellus curtisii Fh.
Norvellina seminudus Say
Phlepsius incisus V.D.
 irroratus Say
 fulvidorsum Fh.
 strobi Fh.
 solidaginis Walk.
 ramosus Bak.
Idiodonus kennicotti Uhl.
 morsei Osb.
Colladonus clitellarius Say
Thamnotettix simplex *var. chlamydatus* Prov.
Cyperana straminea S. & Del.
 melanogaster Prov.
 decipiens Prov.
Elymana inornata V.D.
Graminella fitchii V.D.
Chlorotettix tergatus Fh.
 spatulatus Osb. & Ball
 unicolor Fh.
 lucosus Osb. & Ball
 balli Osb.
Jassus oblitarius Say
Macrosteles variatus Fall
 var. fumatus H. S.
 lepidus V. D.
 divisus Uhl.
 slossoni V. D.
Balclutha abdominalis V. D.
 impicta V. D.
 var. osborni V. D.
 punctata Thunb.
Dikraneura abnormis Walsh
 mali Prov.
Forcipata loca Del. & Cald.
Empoasca atrolabes Gill.
 unica Prov.
 obtusa Walsh
 aureoviridis Uhl.
 smaragdula Fall.
 fabae Harris
 var. mali LeB.
Typhlocyba tenerrima H. S.
 rosae Linn.
 cymba McA.
 gilletti V. D.
 var. apicata McA.
 var. casta McA.
Eupteryx nigra Osb.
 flavoscuta Gill.
Hymetta trifasciata Say

Erythroneura vulnerata Fh.
obliqua Say
comes Say
ziczac Walsh
ontari Rob.
tricincta Fh.
vitis Harr.

FULGORIDAE

Scolops sulcipes Say
Catonia grisea V. D.
impunctata Fh.
Oliarus quinquelineatus Say
humilis Say
Cixius misellus V. D.
basalis V. D.
pini Fh.
stigmatus Say
Bruchomorpha oculata Newm.
Aphelonema histrionica Stal.
Ormenis pruinosa Say
Cedusa vulgaris Fh.
kedusa McA.
Amalopota uhleri V. D.
Stenocranus dorsalis Fh.
similis Crawl.

Kelisia axialis V. D.
Megamelus notulus Germ.
piceus V. D.
uncus Crawl.
Pissonotus marginatus V. D.
ater V. D.
delicatus V. D.
guttatus Spn.
dorsalis V. D.
aphidioides V. D.
Laccocera vittipennis V. D.
burniella ornata Stal.
Phyllodinus nervatus V. D.
Delphacodes laminalis V. D.
lateralis V. D.
kilmani V. D.
pellucida Fabr.
puella V. D.
basivitta V. D.
osborni V. D.
campestris V. D.
lutulenta V. D.
occlusa V. D.
lineatipes V. D.
gilletti V. D.
analis Crawl.

THE DIPTEROUS FAMILY MYDAIDAE IN CANADA

Some months ago, Mr. E. P. Venables sent me for identification an unusual fly, taken by him at Vernon, British Columbia, on July 5, 1907. Professor G. J. Spencer had recognized it as one of the Mydidae, a family of Diptera not previously recorded from western Canada. More recently, Mr. W. J. Brown informed me that additional Mydidae from Oliver, British Columbia, were in the collections of the Department of Agriculture (Division of Entomology) at Ottawa. These he kindly forwarded to me. All these western specimens are *Nemomydas pantherinus* (Gerstaecker), differing in no respect from those I have seen from California, where the species was first taken and is not very rare. Only the female was taken at Vernon; but four females and four males were obtained at Oliver, in July, 1923, by P. N. Vroom and E. R. Buckell. *N. pantherinus* is also recorded definitely from Oregon (Hood River) and rather vaguely from the State of Washington. It was described originally as a *Leptomysdas*, but in 1934 Curran made it the type of his genus *Nemomydas*.

Mr. W. J. Brown also sent me several Canadian specimens of *Mydas clavatus* (Drury) and called my attention to two published records of this fly in Canada. All localities are in extreme southern Ontario, on or close to Lake Erie: Pt. Pelee (N. K. Bigelow; G. S. Walley; recorded by A. Gibson, 46th Ann. Rept. Ent. Soc. Ont. for 1915, p. 212, 1916); Normandale (G. S. Walley); Caradoc (H. F. Hudson); Longwood (G. Blair; recorded by A. Gibson, 49th Ann. Rept. Ent. Soc. Ont. for 1918, p. 116, 1919); Port Stanley (R. Ozburn); and Simcoe (T. N. Freeman).

The Canadian records of these two species establish the northernmost extension of the family Mydidae in America to near 43° N. in the east and slightly north of 50° N. in the west.

J. Bequaert, Cambridge, Mass.

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